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Uni. Roll No. ....

Program: B. Tech. (Batch 2018 onward)

Semester: 3rd

Name of Subject: Thermodynamics

Subject Code: PCME-101

Paper ID: 16072

Scientific calculator is allowed.

MORNING

0 9 MAY 2023

Time Allowed: 03 Hours

Max. Marks: 60

NOTE:

1. Parts A and B are compulsory.
2. Part-C has Two Questions Q8 and Q9. Both are compulsory, but with internal choice.
3. Any missing data may be assumed appropriately.

Part – A
[Marks: 02 each]

1.
   a. What do you mean by property of a system?
   b. State Zeroth law of thermodynamics.
   c. State the first law of thermodynamics as related to a process.
   d. What do you mean by perpetual motion machine of second kind?
   e. Sketch Otto cycle on PV diagram.
   f. Define dryness fraction.

Part – B
[Marks: 04 each]

2. Determine the work done, change in internal energy, enthalpy change and work done during an isothermal process.

3. In a non flow reversible process, the pressure and volume are related by equation $p = V^2 + 10/V$, where p is in bar and V is in m^3. During a process the volume changes from 1.5 m^3 to 4.5 m^3. The heat added during the process is 7000kJ. Determine the change in internal energy.

4. Write generalized steady flow energy equation and simplify it for a steam nozzle.

5. A reversible engine with 40% efficiency discharges 1520 kJ of heat per minute at 27⁰C to a pond. Find the temperature of the source which supplies the heat to the engine and the power developed by the engine.

6. Differentiate between a two stroke and a four stroke petrol engine.

7. Discuss the changes in saturation temperature with pressure for steam. Define Triple point with help of liquid-vapour equilibrium diagram.

Part – C   [Marks: 12 each]

8. Write the statements of second law of thermodynamics and show the equivalence of the two statements.

OR

In an air standard Otto cycle the compression ratio is 7 and the compression begins at 1 bar and 40⁰C. The heat added is 2500 kJ/kg. Determine the work done per cycle, the maximum pressure and temperature of the cycle and mean effective pressure.
Take $c_v = 0.718$ kJ/kg K and R=0.287kJ/kg K.

9. What do you mean by a Carnot heat engine? What are various assumptions considered in operation of a Carnot heat engine? Determine the efficiency of a Carnot heat engine. Why a Carnot heat engine is impossible to be made?

OR

Given that standard pressure and temperature (STP) may be taken as 101.32 kN/m² and 00C respectively, calculate the volume of 1 kmol of a perfect gas as STP. Assuming that air contains 21 percent oxygen by volume, the rest nitrogen, determine the average molecular mass of air, the value of characteristic gas constant and mass of one cubic meter of air at STP. Take molar gas constant as 8.314 kJ/kmol K.

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